CLAIMS

- 1. A method of manufacturing a mechanically robust insulating layer, comprising: forming a low-k dielectric layer having a first dielectric constant on a substrate; and forming a carbon nitride cap layer on the low-k dielectric layer, the insulating layer thereby having a second dielectric constant that is less than the first dielectric constant.
- 2. The method of Claim 1 wherein a composition of the cap layer is C_xN_y , where x ranges between 0.1 and 0.9 and y ranges between about 0.1 and 0.9.
- 3. The method of Claim 1 wherein the low-k dielectric layer comprises a material selected from the group consisting of:

silicon dioxide;

hydrogen-doped silicon dioxide;

fluorine-doped silicon dioxide;

carbon-doped silicon dioxide; and

an organic polymer.

- 4. The method of Claim 1 wherein the carbon nitride cap layer is a first carbon nitride cap layer formed on a first major surface of the low-k dielectric layer and further comprising a second carbon nitride cap layer contacting a second major surface of the low-k dielectric layer.
- 5. The method of Claim 1 wherein the carbon nitride cap layer is formed by a process selected from the group consisting of:

ALD;

CVD;

PECVD; and

PVD.

6. The method of Claim 5 wherein the carbon nitride cap layer is formed by a process gas selected from the group consisting of:

 C_2H_4 ; CH_4 ; and C_3H_8 .

7. The method of Claim 5 wherein the carbon nitride cap layer is formed by a process gas selected from the group consisting of:

 N_2 ;

NH₃; and

 N_2H_4 .

8. The method of Claim 5 wherein the process is PVD utilizing a target comprising a material selected from the group consisting of:

graphite;

azaadenine;

adnine; and

melamine.

- 9. The method of Claim 1 wherein the carbon nitride cap layer has a thickness ranging between about 50 Angstroms and about 800 Angstroms.
 - 10. An integrated circuit device, comprising:

a substrate having at least one microelectronic device located therein; and an insulating layer located over the substrate, including:

a thin-film, low-k dielectric layer having a first dielectric constant; and a carbon nitride cap layer located on the low-k dielectric layer, the insulating layer thereby having a second dielectric constant that is less than the first dielectric constant.

11. The device of Claim 10 wherein the thin-film, low-k dielectric layer has a first hardness and the insulating layer has a second hardness that is greater than the first hardness.

- 12. The device of Claim 10 wherein the cap layer has a composition of C_xN_y , where x ranges between 0.1 and 0.9 and y ranges between about 0.1 and 0.9.
- 13. The device of Claim 10 wherein the low-k dielectric layer comprises a material selected from the group consisting of:

silicon dioxide;

hydrogen-doped silicon dioxide;

fluorine-doped silicon dioxide;

carbon-doped silicon dioxide; and

an organic polymer.

- 14. The device of Claim 10 wherein the carbon nitride cap layer is a first carbon nitride cap layer formed on a first major surface of the low-k dielectric layer and further comprising a second carbon nitride cap layer contacting a second major surface of the low-k dielectric layer.
- 15. The device of Claim 10 wherein the carbon nitride cap layer is formed by a process selected from the group consisting of:

ALD;

CVD;

PECVD; and

PVD.

16. The device of Claim 15 wherein the carbon nitride cap layer is formed by a process gas selected from the group consisting of:

 C_2H_4 ;

CH₄; and

 C_3H_8 .

17. The device of Claim 15 wherein the carbon nitride cap layer is formed by a process gas selected from the group consisting of:

 N_2 ;

NH₃; and

 N_2H_4 .

18. The device of Claim 15 wherein the process is PVD utilizing a target comprising a material selected from the group consisting of:

graphite;

azaadenine;

adnine; and

melamine.

- 19. The device of Claim 10 wherein the carbon nitride cap layer has a thickness ranging between about 50 Angstroms and about 800 Angstroms.
 - 20. An integrated circuit device, comprising:
- a first via contacting a microelectronic device in a substrate and extending through a first insulating layer located over the substrate;
- a first trench contacting the first via and extending through a second insulating layer located over the first insulating layer;
- a second via contacting the first trench and extending through a third insulating layer located over the second insulating layer; and
- a second trench contacting the second via and extending through a fourth insulating layer located over the third insulating layer;

wherein at least one of the first, second, third and fourth insulating layers includes:

- a dielectric layer having a first dielectric constant; and
- a carbon nitride cap layer located on the dielectric layer, the at least one of the first, second, third and fourth insulating layers thereby having a second dielectric constant that is less than the first dielectric constant.
- 21. The device of Claim 20 wherein an etch stop layer interposes at least one pair of neighboring ones of the first, second, third and fourth insulating layers.

- 22. The device of Claim 20 wherein at least two of the first and second vias and the first and second trenches form at least one dual-damascene structure.
- 23. The device of Claim 20 further comprising at least one anti-reflective coating formed over one of the first, second, third and fourth insulating layers.
 - 24. A semiconductor device, comprising:

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- a plurality of doped regions formed in a substrate; and
- a plurality of isolation regions each proximate a junction of adjacent ones of the plurality of doped regions, wherein at least a portion of each of the plurality of isolation regions comprises carbon nitride.
 - 25. A MEMs device, comprising:
 - a landing yoke configured to deflect in response to biasing thereof;
 - a mirror element coupled to the landing yoke; and
 - a control bus configured to bias the landing yoke;

wherein at least one of the landing yoke, mirror element and control bus includes a contact area coated with carbon nitride.